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THE FORESTS OF THE ANTHRACITE REGION

A PROBLEM ANALYSIS

by

Staff of the Anthracite Branch
of the Northeastern Forest Experiment Station
Kingston, Pa.

(Review Draft)

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Anthracite Region

Review draft of

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Approved for review

W. L. Harper

Director

October 1, 1947

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The Forests of the Anthracite Region

A Problem Analysis

INTRODUCTION

For a fleeting moment, let us lift the curtain of time in northeastern Pennsylvania: over hill and valley a solid mantle of green--magnificient stands of white pine and hemlock, maple and beech, oak and chestnut, many of them running 100,000 board feet per acre. Sawmills turning out 30,000,000 board feet of lumber per year. Timber so plentiful that hemlocks were felled for the bark alone for tanning, the wood being disdained as unfit for use and left to rot in the woods. Such were the forests of the Anthracite Region a century ago--an apparently inexhaustible bounty of Nature. The climate was favorable, soils were favorable, fires were rare; trees grew with vigor, matured and died as became their kind, and were replaced by others without break in the endless splendor of the wilderness. Streams ran clear and full; disastrous floods were unknown.

But Nature had also bestowed another and more highly valued bounty underground, upon which was founded in the middle 1800's the anthracite coal industry. With improved and extending transportation facilities came widening markets; the industry expanded and prospered, and soon came to dominate the regional economy. That domination has continued to the present day. The forests were exploited lavishly and wastefully, in keeping with the custom of the times, and with no thought for the needs of tomorrow. Timber was still plentiful elsewhere, should local supplies run short.

Coal was king. Cutting of the forests frequently was followed by fire; and through the years, with continued public apathy toward the forest resource, most of the timberlands burned again and again. After each burn came poorer soil conditions, higher runoff of water, and poorer quality of new forest growth.

Because of the unique market for small timbers used as props and lagging in the mines, second-growth stands have been recut repeatedly as soon as they reached pole size. Today, except for occasional small private preserves, few good saw-timber stands remain in the region, and many of the younger stands are in a state of low productivity from abuse and neglect. A valuable natural resource has been so badly damaged that its present capacity for furnishing employment and contributing to the wealth of the region falls far short of what it should be. Despite past abuse, however, most of the forest lands still are capable of growing good timber. With proper management and fire control, these lands can again become productive and assume their rightful place as a supporting resource of the Anthracite Region.

THE REGION

The Anthracite Region as here defined comprises the 15 northeastern Pennsylvania counties as shown on the map in Figure 1. This unit includes the six principal coal-producing counties of Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, and Northumberland, together with nine adjacent counties which supply a substantial part of the needs for mine timber. Total area of the 15 counties is around 5¼ million acres, of which 61 percent, or 3,198,400 acres, are forest land. Yet we have the incongruous

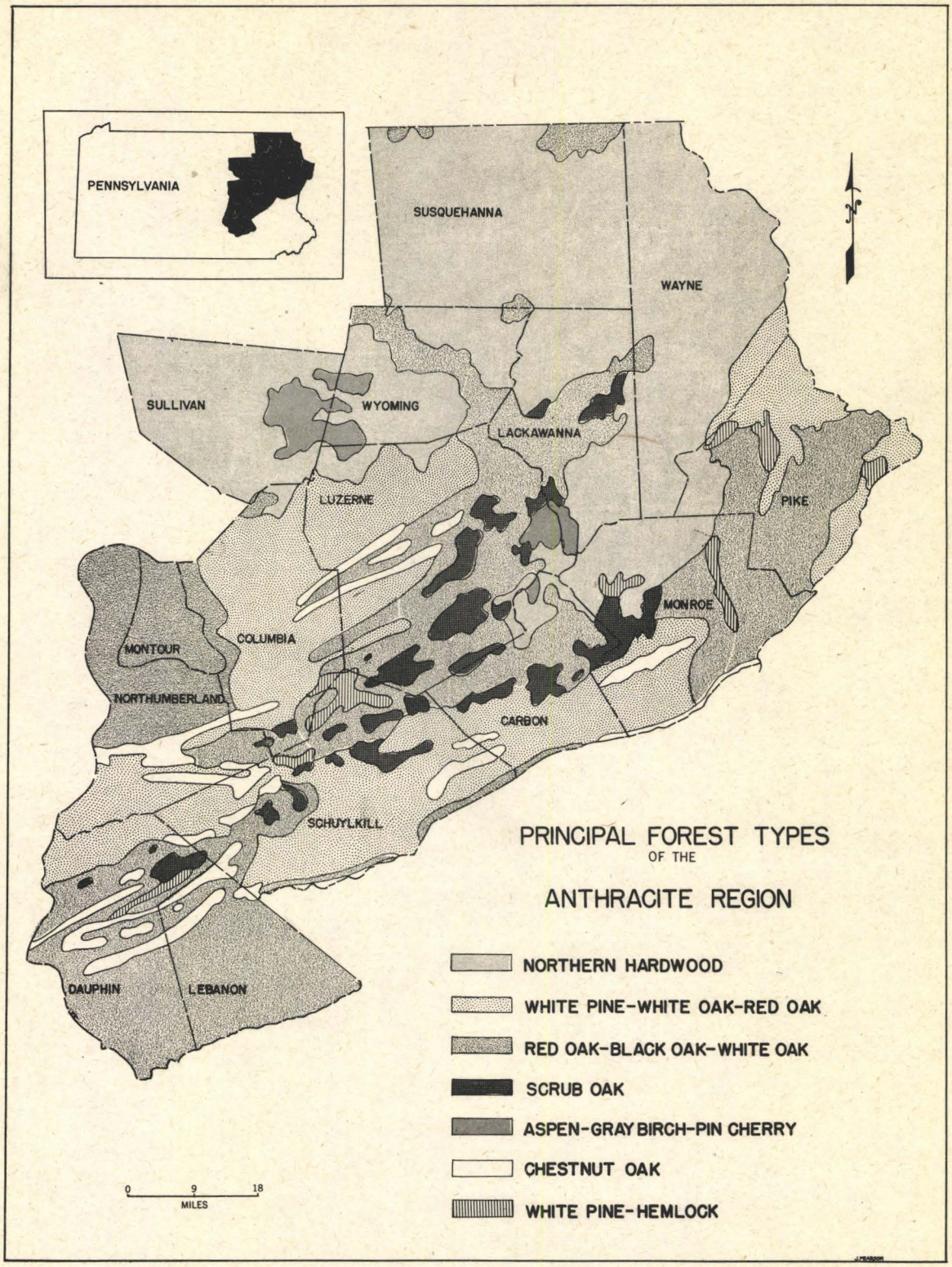

PENNSYLVANIA
SUSQUEHANNA
WAYNE
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
PIKE
MONROE
COLUMBIA
MONTOUR
NORTHUMBERLAND
CARBON
SCHUYLKILL
DAUPHIN
LEBANON
0 9 18
MILES
PRINCIPAL FOREST TYPES
OF THE
ANTHRACITE REGION
NORTHERN HARDWOOD
WHITE PINE-WHITE OAK-RED OAK
RED OAK-BLACK OAK-WHITE OAK
SCRUB OAK
ASPEN-GRAY BIRCH-PIN CHERRY
CHESTNUT OAK
WHITE PINE-HEMLOCK

Figure 1.

situation of this huge acreage of potentially highly productive forest land yielding only about 9 million dollars worth of forest products per year, while around 8 million dollars are expended annually outside the region for additional forest products that could be locally grown (1943 data). Of the total annual regional income of 469 million dollars for produced or manufactured goods, forest products, including those produced from imported materials, account for only about 3.5 percent; mining accounts for 201 million dollars, or 43 percent, and even agriculture in this largely non-agricultural region accounts for about 10 percent--almost three times as much as the forest products.

On the employment side of the picture, the total number of jobs in 1945 was 493,000, of which only 7,100 or 1.4 percent were in forestry and the processing of forest products; mining, with 80,400 jobs, provides over 16 percent of the total employment. Clearly, the forests and forest industries are contributing a disproportionately small part to the economy of the region. According to studies made by the Northeastern Station, the forests and forest industries, if properly developed and managed, could provide employment for 30,000 persons and could yield products valued at 75 million dollars per year.

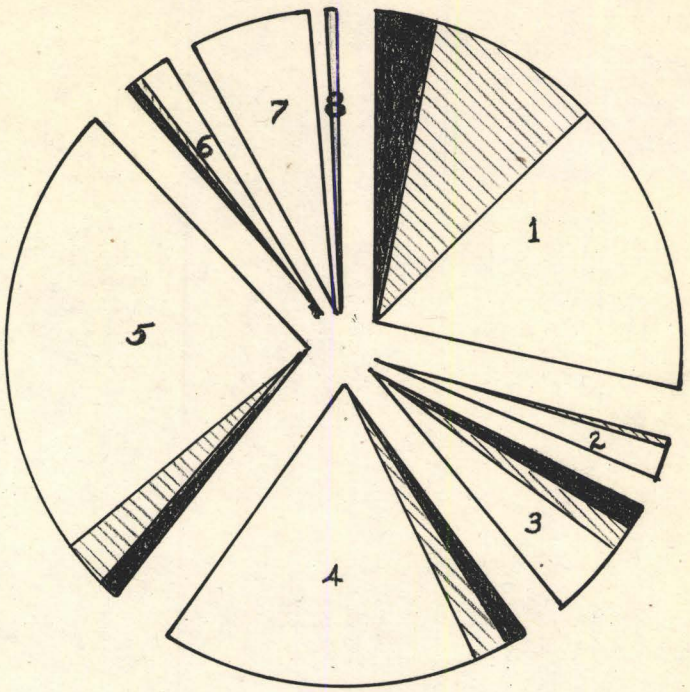
Though the anthracite coal industry still provides by far the largest number of jobs outside the trade and service field, it has been steadily reducing its labor force for many years. Whereas 150,000 men were employed at the turn of the century, only about half that number are now on the payrolls. Except for the war period, unemployment has been a serious

problem in the region for the past 20 years. Despite a general decline in population--Luzerne County has lost almost 28,000 people since 1940--there are now about 18,000 unemployed in the Wilkes-Barre area alone, and civic leaders and organizations are belatedly beginning to show concern about the needs for additional industries to broaden the employment base. Though perhaps insufficient to warrant a statement that the regional economy is sick, such symptoms certainly indicate that it is not in a state of robust health. Fully productive forests with related industries could contribute a good deal toward alleviation of these unemployment ills.

Fully developed and properly managed forests also would confer tremendous benefits to the region by reducing flood damage and stabilizing the flow of streams. Floods of some magnitude we may always have, but that establishment of better forest conditions would lessen the intensity of floods is incontrovertible. And reducing the crest of a disastrous flash flood by but a few feet could well prevent damages running into millions of dollars.

PRESENT TIMBER RESOURCES

Distribution of the seven major forest types recognized in the Anthracite Region is shown on the map in Figure 1. In Figure 2 (and its accompanying table) is shown the percent of the total forest land area occupied by each type, and a breakdown of each type into three condition classes of saw-timber, pole-timber, and seedling-sapling growth.



KEY

Saw-timber stands — Over 2,000 board feet per acre

Pole-timber stands — Over 400 cubic feet per acre but less than 2,000 board feet

Seedling-sapling stands — Less than 400 cubic feet per acre

ACREAGE

No.	Type	Saw timber	Pole timber	Seedling & sapling	Total	Per-cent
1	Northern hardwood	82,700	315,300	524,700	922,700	28.9
2	Aspen-gray birch	--	6,600	91,500	98,100	3.1
3	White pine-hemlock	43,800	57,900	144,800	246,500	7.7
4	White pine-oak	23,000	95,800	536,500	655,300	20.5
5	Red oak-white oak	26,000	122,800	766,400	915,200	28.6
6	Chestnut oak	1,500	15,000	99,300	115,800	3.6
7	Scrub oak	--	--	231,500	231,500	7.2
8	Other	400	1,100	11,800	13,300	.4
	Total	177,400	614,500	2,406,500	3,198,400	100.0

Figure 2.

Three types--northern hardwood, red oak-white oak, and white pine-oak--occupy 78 percent of the approximately 3.2 million-acre total. The white pine-hemlock type is relatively small in acreage but important in that it occurs on the most productive sites. Chestnut oak is a ridge type of small importance for timber. Two types--aspen-gray birch, and scrub oak--which together occupy 10.3 percent, or nearly 330,000 acres, are essentially unproductive. In addition, there are an estimated 150,000 acres in mine spoil banks that are not only unproductive and unsightly, but also acute problem areas in respect to flood intensification and siltation of streams.

Approximately 5 percent of the forest area can be designated as saw-timber stands (2,000 or more board feet per acre), though most of these are in extremely poor condition from over-cutting, fire, or both; 75 percent is in the seedling-sapling stage, hence can not come into timber production for several decades; the remaining 20 percent in pole timber can, under management, yield some mine timber while being brought into saw-timber production. Under present practices in the region, these pole stands usually are clear-cut as soon as large enough to yield a few tons of props and lagging, and thus are thrown back into the seedling-sapling class.

Because of understocking, soil deterioration and tree injuries from fire, and the predominance of the seedling-sapling age class, average annual growth is roughly about one-third of what it could be under reasonable standards of forest management. Obviously, very little of this growth

volume is accruing on trees of sawlog size, because such trees simply are not here in adequate number.

THE PROBLEMS

Defined in broad terms, the over-all problem in the Pennsylvania Anthracite Region is one of an unbalanced industrial and economic organization. Too much emphasis and dependence rests upon the coal resource and industry. With more efficient mining methods, requiring less labor, and stiff competition which limits markets, the industry simply cannot carry the load. Unemployment has become a chronic ailment, sapping the economic lifeblood of the entire region. The future appears even bleaker, inasmuch as the northern anthracite field is expected to be essentially worked out within the next few decades. To forestall further decline, the region must develop other industries and capitalize upon its other natural resources, among which its 3.2 million acres of forest land and the forestry potentialities of that land probably rank second to coal in importance.

It is not appropriate here to elaborate further upon regional economic conditions and problems other than to point out that improvement and proper management of the forest resource can help very substantially toward bettering those conditions, and absorbing the economic impact of further declines in the coal industry as fields become exhausted. The primary purpose of this analysis is to outline certain problems in the forestry field which require solution if the forests are to make their full

contribution to the public welfare. Forestry problems fall into two broad categories: (1) problems requiring research--the finding of more efficacious ways for managing woodlands, together with costs and financial returns; and (2) problems concerned with getting the best forest management practices to the people and into operation in the woods. The main function of forest research workers is to solve, insofar as possible, forestry problems in the research category and to disseminate their findings. This is the function participated in by the Northeastern Forest Experiment Station and its various branches, of which the Anthracite Branch is one. The next step--getting new or better forestry into the woods--is for the most part the responsibility of state and local agencies, both public and private, with such Federal help as the Congress provides. This job will not be elaborated upon further in this analysis. Forest research problems, with which we are here concerned, may be broken down into the following general classes:

1. Forest protection
2. Forest rehabilitation
3. Planting of denuded areas
4. Lack of working tools in forest management
5. The problem of Cost and Returns--Does forest management pay?
6. Timber harvesting and utilization, marketing
7. Influence of forests upon water and soils
8. Game management in relation to forests
9. Recreation in relation to forests

Problems in each of these classes as they relate to conditions in the Anthracite Region will be designated and discussed briefly in the pages following.

FOREST PROTECTION PROBLEMS

Forest protection in the public mind usually means fire protection. However, fire is but one of the destructive factors that under good forest management must be controlled. Insects and diseases take a steady toll from the woods and in the event of a widespread epidemic such as the current outbreak of spruce budworm in the Adirondacks and Canada, may be far more devastating than fire. In farm woods, protection against domestic animals is important. Occasionally, problems arise in relation to wildlife. Protection problems do not appear to occupy a place of high priority in the program of the Anthracite Branch Station. They are mentioned first because fire prevention particularly is the first and paramount hurdle to surmount on the road to productive and profitable forestry.

Fire

Forest fires are destructive in many ways: they not only destroy growing timber together with the seeds, seedlings, and sprouts of the next generation--fire also destroys game, beneficial song birds, insects, and other desirable forms of wildlife, especially in spring burns when the helpless young are caught in its searing grasp. Ashes washing into the streams are detrimental to fish and the aquatic life upon which fish are dependent; destruction of the forest canopy permits abnormal warming of the waters by the sun and renders them unsuitable for some cold water species, such as the native brook trout. Fire consumes the crucially valuable litter and humus of the forest floor--that great natural sponge and soil conditioner so essential for the regulation of water runoff and

absorption, and the control of floods. Repeated fires are largely responsible for the widespread occurrence of worthless bush and scrub types of growth, such as the local aspen-gray birch and scrub oak types. Lighter fires in the woods, popularly believed to be harmless, leave scars on the trees through which wood-rotting fungi invade. Such trees may live and grow, but 20 years later are worthless culls from heart rot. Runaway wild fires may destroy developed property such as buildings and fences, and occasionally human life; they ruin scenic and recreational values, leaving only barren desolation and poverty in their wake.

The Anthracite Region has long been known among foresters and conservationists as the most acute fire-problem area of Pennsylvania. Here, on 18 percent of its area, the State has been spending nearly half of its fire-control funds. Progress has been made; 25 years ago, more than 112,000 acres burned over annually, now it has been reduced to around 25,000 acres. The average number of fires, however, has increased from 1250 to 1650 per year. This means but one thing--public indifference and carelessness--otherwise no such number of fires would get started. The smaller acreage burned reflects the increased efficiency of fire suppression organizations. Twenty-five thousand acres burned--almost one out of every hundred acres each year--still is far too high a price for a progressive community to lay before the altar of public apathy and carelessness. What can be done about it?

Primarily, the fire-control job is one for an enlightened citizenry to carry out with the aid and leadership of the State forestry organization.

The Anthracite Branch of the Northeastern Station could do research as seems necessary in the development of instruments and techniques to facilitate the work of fire prevention, detection, and suppression. Among these may be mentioned the following:

1. Estimation of fire danger. This would involve correlating the present Forest Service fire-danger meter with local fire danger in each of the various fuel types, thereby providing an improved tool for the day-to-day use of suppression forces in rating the degree of hazard and determining appropriate precautionary measures and action.

Studies made during the past 2 years in seven of the major fuel types in the Anthracite area provide data that will be helpful in evaluating the effect of local fuel types on present danger measurements. A careful analysis of this data may bring out facts that will make such a correlation possible.

2. Estimation of fire damage--the development of guiding principles and standards for placing authentic dollar-and-cents values on fire damage. Appreciation by the public of the losses suffered by fire would bring realization of the dollar economy of fighting fire before it starts, rather than afterward. This is a big task which the present staff is not adequately equipped to handle. It would be better undertaken as a special job on a broader scale than for a single region.

3. Fire protection methods--the most effective and economical types of fire breaks, and methods of maintenance. Experimentation with the newer chemical herbicides for fire-break maintenance might lead to substantial savings. Some such studies may become necessary as a part of

protecting test areas, as for example planting studies in scrub oak.

4. Education--both in the schools and for adult groups. Research workers ordinarily would not engage in such activities directly, but could assist by supplying information, and perhaps display materials or speakers for appropriate meetings.

Insects and Disease

The Anthracite Region at present is relatively free of acute forest insect and disease problems, and no projects in this category are contemplated at this time. The Experiment Station maintains cooperative relations with the Federal Bureau of Entomology and Plant Quarantine, the Division of Forest Pathology, and with State agencies. These agencies would come actively into the program if evidence of an impending epidemic in their respective fields appeared. A few years ago, upon threat of an epidemic of gypsy moth, the Bureau of Entomology and Plant Quarantine established a local office which has successfully directed a control program against that insect.

Certain insects and diseases, such as the white pine weevil and the chestnut blight, have thus far defied practicable control measures and we are forced to make the best of an undesirable situation. With the chestnut, a valuable species has been eliminated from the forests and replaced by other kinds of trees. The weevil does not eliminate white pine, but seriously curtails its utility in the forestry program, especially as a species for establishment in plantations.

With most forest insects and diseases, however, when present in normal numbers, losses can be reasonably well controlled and minimized

by good silviculture and forest management. This means simply exclusion of fire, harvesting at the proper time and by proper methods, thinning as required to keep young stands growing vigorously, and sanitation cutting of old cull and diseased trees. As will be discussed in succeeding pages, research is needed to determine the most effective, financially feasible measures for promoting the vigor and general productivity of forest stands. Efficacy in minimizing losses from insects and disease will be among the criteria used for evaluating those silvicultural measures.

Animals

Forests and pasture do not blend well on the same piece of ground. Livestock browse off the tree reproduction, destroy the humus mat and compact the soil by their trampling. Existing trees decline and no new ones replace them. The problem here appears to be mainly one of education to be carried out by farm foresters and others who have opportunity to point out the false economy of running livestock in the woods. The scant bit of forage gleaned from such pasturing normally falls far short of compensating for the losses in timber values and in the timber-growing potentials of the soil.

Wildlife is a normal complement of the forest. Under virgin conditions they existed together in harmony. With the disturbances of man's occupancy and use of the land, unbalances develop through alteration of food and cover conditions, predator control, artificial stocking, protection from hunting, and like manipulations. Thus we have instances of deer or rabbits becoming so plentiful that they browse off all tree

reproduction in their struggle to avoid starvation, we have deer consuming every acorn that the squirrels allow to reach the ground, we have mice searching out and devouring every fluttering pine seed long before the day when its embryonic needles might have opened to the sun.

The solution of these problems lies largely within the province of the game manager or wildlife investigator. Forest research ordinarily enters this field only in quest of better ways to protect young trees or tree seed in plantations and nurseries. Many alleged animal repellents have been tried, none very successfully. The extent to which wildlife affects forest regeneration in the Anthracite Area is not definitely known. Studies at Penn State College indicate that mice do seriously restrict pitch pine reproduction in the scrub oak type. Inasmuch as the Anthracite Branch Station will be concerned with methods for seeding and planting in the scrub oak and aspen-gray birch types, we may be forced into studies of methods for rodent control.

FOREST REHABILITATION---A MAJOR PROBLEM

Development of effective and economically practicable methods for rehabilitating the depleted woodlands of the Anthracite Region into healthy, productive forests is the major job of this Branch Station, and the urgent need for doing that job is the foremost justification for the Station's existence. In broad terms the job is one of silvicultural research tempered by the economics of forest management.

To recall some figures from Figure 2, 75 percent of the forest land is classed as seedling-sapling growth, 20 percent is pole timber

subject to cutting for props and lagging, and only 5 percent qualifies as saw-timber stands of more than 2,000 board feet per acre. Under present practices, stems down to 2 inches d.b.h.[1/] are cut for lagging, except the inferior species such as aspen, sassafras, gray birch, pin cherry, and beech. These are left to stand and reproduce, unless killed by an ensuing fire; thus both their actual and their proportionate numbers in the stands tend to increase with each cutting. Reduction of the inferior species and rebuilding these mismanaged and depleted forests presents many problems. We must find out how to bring them into full production by financially sound procedures, and without delay. The economic welfare of the region depends in no small part upon this accomplishment.

Surveys and preliminary studies at this station in recent years provide the basic data on the seven important forest types--their location and acreage, and their composition, volume, quality, and growth rates by site and stand-size classes. Upon this basic information we can predicate apparently logical or promising silvicultural treatments. The next step is to test these measures to determine their effect on development and productivity of the stands over a period of years. Inasmuch as each type and stand size-class differs in several important aspects, each will require consideration on its individual characteristics. Each type is discussed briefly below.

1/ Diameter at breast height--4.5 feet.

Scrub Oak Type

Scrub oak is a nonproductive, degenerate form of oak type stands, created and maintained by repeated fires. Pennsylvania contains some 2,000,000 acres of scrub oak land, of which 231,500 acres are in the Anthracite Region. Evidence from a small study at this Center and from work done elsewhere indicates that, with exclusion of fire, the scrub oak will give way to taller tree species in about 40 years. However, this first tree generation typically is of inferior species and of poor form; without definite cultural treatment probably another 40 years or more would elapse before the forest would begin to display good form and species composition.

Recent developments in Monroe County indicate that some scrub oak land has possibilities for agricultural use. Harvesting wild blueberries from this type is an established local industry, and is the basis for considerable deliberate burning. Hence there is need for studies in land use--what are the criteria of potential agricultural land, what kind of land and how much might best be devoted to blueberries, and what to forestry. Unquestionably, most of the scrub oak area would be best used for forests, which raises the question of what can be done to bring about conversion to a desirable type without waiting for the slow and irregular process of natural succession. In view of the acreage involved, now almost totally unproductive except for blueberries, and often tax delinquent, an effort to solve this problem deserves high priority. Artificial planting or direct seeding of trees appears to be the answer, but under the peculiar difficulties of the situation no one knows how

to do it successfully, what kinds of trees to use, or how much it will cost. The Station proposes to start studies of these problems at once; first to determine how to do the job, then to reduce those procedures by mechanization to an economically practicable basis.

Aspen-Gray Birch Type

Aspen-gray birch, like scrub oak, is regarded as degenerate type brought about by repeated fire--in this instance originating from the northern hardwood type. Surveys show over 98,000 acres of aspen-birch in the Anthracite Region; thousands of acres also are found elsewhere in the State. With fire protection alone, natural conversion of this type to one of better species composition proceeds much more slowly than in scrub oak. Studies in the Lake States indicate that artificial measures involving thinning and underplanting are required there to convert aspen-birch within any reasonable period of time. Similar measures need to be tested in the Anthracite Region.

Red Oak-White Oak Type

This is a widely distributed upland type occupying 915,000 acres in the Region, second only to the northern hardwood type in area. The type as a whole is in extremely poor condition. Covering 28.6 percent of the Region's forest area, it comprises only about one-eighth of the saw-timber and less than a fifth of the timber tonnage; 84 percent of it is in the seedling-sapling stage. Fire and excessive cutting have resulted in stands composed largely of poorly formed, defective trees and an unduly high proportion of inferior species. All stand size classes badly need treatment--principally improvement cuttings.

In the seedling-sapling stage these cuttings should involve thinning of sprout clumps and weeding out inferior species sufficiently to bring through an adequate stand of sound, straight trees. In the pole class the requisites again are thinning coupled with felling of inferior species and defective stems wherever they will interfere with future development of the stand. In saw timber the primary need is to remove crooked, diseased, low-quality trees that are occupying valuable growing space, so that younger stems of better quality can develop. Since these stands now average only 4,200 board feet per acre, little harvesting of sawlogs can be done until the volumes have been built up through increased stocking and growth.

The moot questions are how heavy and how frequent such cuttings should be, what they will cost, what will be the immediate returns, and what will be the delayed returns in enhanced value of forest capital and better timber harvests in the future. Improvement cuttings in pole and saw timber yield marketable materials usually sufficient to yield a reasonable profit to the operator and some income to the landowner. A recent study at this station in a 30-year old oak stand indicates that in such situations a 50-percent cut by volume for mine props and lagging can be a mutually profitable operation and still leave--not the devastation of clear cutting--but a vastly improved woodland from which another cut can be anticipated in about 10 years. Further studies of this sort are urgently needed in different age and condition classes of stands to determine the best procedures both silviculturally and economically, that is, considering both the future development of the forest and the necessity for providing immediate as well as future income to the owner.

White Pine-Oak Type

This type is similar in many respects to the white oak-red oak type, except for the intermixture of white pine. Typically it occupies somewhat better sites than white oak-red oak, and is therefore potentially more productive. Because of excessive cutting of the white pine and the inability of this species to reproduce well in competition with hardwood growth, much former pine-oak land has become essentially a pure oak type. The conditions prevailing in the two types and their silvicultural and economic problems are much the same, except as modified by consideration of the pine. White pine is a valuable and highly prized species. Its place in the forests should not only be maintained but extended insofar as practically possible. Consequently the problems in this pine-oak type involve more than the general objective of stand improvement--they involve also the favoring of a particular species which reproduces none too readily in the brushy, sprout-ridden situations which usually prevail. Research's unique job and challenge is to find effective and economically feasible ways to so manage these stands that the white pine will resume its former important role.

The Northern Hardwood Type

In area, this type is the largest in the region with 922,700 acres. Distributed mostly in the northern counties somewhat removed from the coal fields, it has suffered less abuse and is in relatively good condition. With 29 percent of the Region's forest acreage, it contains 45 percent of its saw-timber volume. However, it has been consistently overcut and poorly managed, and in consequence is producing far below its capabilities. Present sawlog stands average only 4,500 board feet per acre;

properly handled, they should be carrying three or four times that volume.

The northern hardwood type typically occupies highly productive forest land and contains several choice species, such as black cherry, white ash, sugar maple, and basswood. Studies made elsewhere indicate that northern hardwood should be handled under a selection system of cutting, but we face many unanswered questions as to how to increase the proportions of the better species and suppress low-value ones such as beech, and what are the costs and returns of different silvicultural measures and methods of management.

Because of its acreage and productive potential, the Station is pushing plans to start investigative work on northern hardwood problems at once. A long-term lease agreement for a tract of 2,000 acres of this type in Wayne County has been executed. Here on cutting compartments of 10 to 40 acres it is planned to test on a pilot-plant basis different silvicultural treatments and methods of management, such as varying lengths of cutting cycles, intensities of cutting, methods of harvesting and utilization. Also as outlined later under the section "Does good forestry pay", the financial aspects, i.e., costs and returns, of the various treatments and management practices will be carefully considered. Smaller sample plots will be used to investigate gaps in silvicultural knowledge that do no fit into the pilot-plant program. Later, the findings from sample-plot studies may be incorporated into the treatment schedules of the cutting compartments. Results from all these studies as they materialize will become the guideposts and set the pattern for profitable management of the northern hardwood type by private landowners.

White Pine-Hemlock Type

This is a type of cool, moist slopes and ravines, occupying less than 8 percent of the forest area, but potentially the most productive type in the Region. Under the impact of heavy cutting and fires, much land formerly in this type has gone over partly or entirely to hardwoods; the pure type persists mostly in moist pockets and along streams where the fire hazard is low. Because of greater market preference for the pine and greater ability of hemlock to reproduce in shade, second growth stands run largely to hemlock, or hemlock and hardwoods. As in the white pine-oak type, one of the crucial silvicultural problems here is how to increase the proportion of white pine.

Seedling-and sapling stands of this type often develop in such high density that growth is slow and the light-demanding white pine tends to get shaded out. Here it appears that thinning to favor the pine, and perhaps pruning of selected crop trees as they develop through the pole stages, would be a paying proposition. The pertinent question is to what degree in the various stand-size classes are thinning and pruning financially feasible and silviculturally sound.

Chestnut Oak Type

This is a ridge type typically occupying sites of low growth potential. Since it represents but 3.6 percent of the forest area, it will always be relatively unimportant in terms of timber products and silvicultural problems in it are given a low priority. Chief value of the type lies in its role of providing watershed protection and game food and cover.

Chestnut oak wood is strong and durable. Commercial cuttings would produce ties and mine timbers, and the bark is a commercial source of tannic acid. Eventually studies should be made to determine the best methods for utilizing the products of this type without destroying its other values.

PROBLEMS IN FOREST PLANTING

Four types of situations in the Region present problems in the establishment of trees by seeding or planting. These are: (1) scrub oak areas, (2) aspen-gray birch areas, (3) abandoned farm land, and (4) mine waste banks. The first two have been touched upon in the preceding silvicultural discussion of the types; problems relating to the latter two situations will be pointed out below.

Abandoned Farm Land

About 50,000 acres of abandoned farm land are estimated to lie within the Region. Much of this is not restocking adequately by natural seeding, and planting usually is recommended. The State provides planting stock at cost and thousands of trees are planted on such land each year. Though we do not have an authoritative survey, indications are that an unduly high proportion of those plantings fail. The first need is for surveys to determine the extent of actual failure, and, if possible, the reasons why. Foresters have assumed they understood pretty well how to plant conifers, though there are unsolved problems in the field planting of hardwoods. Possibly farmers are not following the best known planting practices, or are using the wrong species, and

should have better guidance. If failures are found to occur frequently even when recommended species and methods are used, then the Station should undertake to develop better procedures. If, however, failures are mostly due to carelessness or misinformation, the remedy lies mainly with the extension services, and State and farm foresters.

Many hardwood plantings fail, even when done by approved methods. The reasons are not fully understood. This problem does not merit high priority in this region, but it should be solved reasonably soon. At present many State nurseries produce few hardwoods and distribute those reluctantly because the plantings are so uncertain.

Mine Waste Banks

The problem of the mine waste banks is unique to the Anthracite Region; it is only superficially similar to the situation in the Bituminous fields. Aerial photos of the Region taken in 1938-39 show about 100,000 acres in refuse banks; with the increased stripping operations since then, total acreage is estimated now to approach 150,000 acres. The mine waste areas are not only unsightly and unproductive; they create serious erosion and sedimentation problems; the deep, steep-walled pits and high, narrow piles are a hazard to life and limb; the pits collect water which sometimes drains into the deep mines, sometimes stands as stagnant pools breeding mosquitoes and otherwise menacing the public health; real estate, scenic, and recreational values are depressed or destroyed by the proximity to mining operations. Nearly a million tons of solid mine waste annually enters the Schuylkill River alone; untold thousands of tons foul other streams, slough over highways, or

pollute the air with dust. Public welfare demands that the waste areas be vegetated wherever possible, for both aesthetic and utilitarian reasons.

Waste from stripping operations makes up the greater part of the barren acreage; various types of deep-mine waste, classified as mine rock, breaker refuse, culm, silt, and boiler ash, make up the remainder. Typically, all these wastesare highly acid, run so high in rock or coal that plant growth is difficult, and often stand at such steep slopes that sloughing, high runoff of water and concomitant drought conditions make plant establishment extremely precarious. In general the stripping banks, to the extent that they contain soil material, will support better plant growth than deep-mine waste. On the whole, however, natural revegetation of all types of waste areas is very slow, often falling far short of full cover even after 20 or 30 years. We need to find some practicable way to accelerate the process.

The recently passed State law requiring revegetation of new strippings charges the State Bureau of Forestry with laying down planting specifications. Upon the forest research workers falls the responsibility for determining the best species, planting or seeding techniques, and methods of site preparation for the various oil and slope conditions. Considerable preliminary experimentation has already been done by the coal companies, civic organizations, and others. A careful examination of these tests, together with review of work done in waste areas in the Bituminous fields, will help define the planting problems and serve as a basis

for planning a sound research attack. Work on this job from this Center should be started soon, with the first test planting in the spring of 1948.

NEED FOR WORKING TOOLS

To properly conduct studies in, or to practice forest management, certain working tools such as volume and growth tables, converting factors, etc., are required. In this category the Station has already accomplished the following:

1. Issued preliminary site-class volume tables for the 15 more important lumber species of the region. Revisions are planned on the basis of additional data acquired later.

2. Issued tables showing stump diameters in relation to diameters at breast height.

3. Assembled growth data by species, sites, and size classes--soon to be published.

4. Prepared weight tables by size classes and species--soon to be assembled and issued.

5. Started developing mathematical factors for converting board feet to tons by species and log sizes.

Such material is useful to landowners, timber buyers and sellers, farm foresters, forest managers and others dealing with growing timber or raw forest products. Moreover they are basic tools needed by forest research workers, particularly in stand management studies. Probably these working tools will be assembled later into a pocket-size manual and issued

in limited numbers, with revisions whenever warranted by new or more extensive data.

DOES GOOD FORESTRY PAY?

Silviculture--the art of growing good trees--is not an end in itself, but a means to higher forest production and greater financial returns. To be practicable and readily applied by landowners and operators, silvicultural practices must pay. Skepticism on the part of timberland owners that they would pay has been one deterrent to the adoption of recommended practices in the past. On the other hand, cutting methods that look only to high immediate returns often pay the least in the long run. The objective should be methods of forest management that will yield the best rate of return, considering the silvicultural requirements of the forest, the needs of the owner, and the economy of the region.

Costs and returns therefore will be considered in all silvicultural and management tests. We need to know how much it costs to do the various operations of felling, limbing, skidding, loading, and hauling of all materials removed under different cutting intensities from different kinds and sizes of trees, harvested for different types of products, under different forest conditions and systems of management. By the same token, we need to know the returns and silvicultural advantages from doing these operations in different ways and under different conditions. For instance, we may compare on one hand the costs of felling and subsequent woods operations under different intensities of cutting, while on the other hand comparing the immediate and future returns from

stands so handled. Such a study has already been done through the stage of immediate returns in an oak pole stand cut for mine lagging and props. Or, we might compare such things as the costs and returns of making light cuts frequently versus heavier cuts at longer intervals; or of harvesting for a single product such as mine timbers versus integrated utilization whereby logs are segregated and marketed as sawlogs, mine timbers, fuel, etc., according to species and grade. A pertinent question in this region is whether all forests should be managed for sawlogs with mine timbers taken only from thinnings and tops, or whether some types would pay better if deliberately managed on short rotations for mine timber.

In all these financial aspects studies immediate costs and returns are but part of the story; the ultimate considerations are quantity and quality of timber yields in relation to costs, and net money returns year after year. To these should be added also the less tangible values of watershed protection and flood control, which mean real dollars and cents in many places. Financial aspects of the various operations and management systems will be an integral part of the program on the previously mentioned experimental forest in the northern hardwood type. Work on that forest should soon begin to answer in convincing terms the question of whether good forestry pays, and to show which practices and methods of management pay best.

Planting research in the scrub oak and aspen-birch types will at first be pointed mainly toward finding methods for getting trees established and growing successfully. Once this is accomplished, the financial aspects of different methods, and of planting as an enterprise will be considered.

Planting on mine waste is in a different category. We probably should not expect to grow much volume of salable forest products on most of these areas for many years; hence the financial feasibility of such planting will have to be judged largely by less tangible factors such as soil stabilization and aesthetic values.

TIMBER HARVESTING, UTILIZATION, AND MARKETING

Nowhere in the Northeast can timber be utilized as completely as in this region. The problems in logging, processing and marketing are, with a few exceptions, not in finding markets, but in producing the kinds of products and so grading them as to realize the highest returns.

The exceptions in an otherwise ample market concern the so-called inferior species which the mines will not use, such as beech, aspen, sassafras, and gray birch. The finding of markets for this material would be a real boon; besides providing extra immediate income from forest lands, it would stimulate removal of these species from the stands and permit better species to come in. Pulp mills or hardwood distillation plants seem to be the most likely outlets for this low-grade material. However, before any serious attempt is made to attract new industries of this sort, a study of the Region's present wood requirements should be made. This, together with estimates now available of the Region's wood-productive capacity, would indicate whether a sufficient surplus would exist to support other wood-using industries.

Establishment of commodity grades is needed. Species and log quality

are not now segregated and marketed separately to any appreciable extent. Good ash, cherry, and maple are bucked into props and sold by the ton when much better prices could be obtained by processing them for lumber.

Another need is to discard the Doyle log rule for measuring board feet in logs. This served very well in an earlier day when logs ran larger, but is grossly unfair to the seller of small material. The International rule provides a much more accurate measure, and is favored by many forestry agencies.

Efficient methods of timber harvesting and marketing are an integral part of good forest management. Savings often can be effected by mechanization of woods work--power saws, tractor skidding, and the like. Since these factors may considerably alter the costs-and-returns aspects of different management measures, they will have a definite part in our pilot-plant tests.

FLOODS AND EXCESS WATER A BIG PROBLEM

In 1935 and 1936, flood waters from the Susquehanna River took 52 lives and caused $100,000,000 damage. Looking back over the record, we find disastrous floods occuring in 1934, '33, '14, '13, '02, '01, 1889, and 1865. Yet the Indians had no tradition of floods along the river. There seems little doubt that the great floods came only with heavy settlement and land clearing, and became increasingly frequent as the forests were more intensively cut and burned. Since 1936 millions of dollars have been spent in flood-control structures, and more may be needed

unless steps are taken to hold or retard the drainage of more of the water from tributary watersheds. For this purpose a well developed forest, with its sponge of litter and the soil porosity that litter maintains, are unsurpassed. This has been verified by many experiments and measurements in other regions.

No one can say today to what extent full rehabilitation of the Anthracite forests would mitigate susceptibility to floods, except that it would be substantial. In all probability, proper management of the forests for timber would provide fairly adequate water-control outside the mining sections. Completion of the proposed flood-control surveys on the Susquehanna and Lehigh drainages would greatly help to identify the more serious flood problem areas, and to outline corrective measures.

In the mining sections with their denuded areas and burned-over forest lands, flash floods are a common occurrence. Besides causing the usual types of property damage, these waters often move tremendous quantities of mine waste that clogs sewers and stream channels, obstructs highways, silts in reservoirs down stream, and destroys fish and aquatic life. In some instances the waters find entrance to deep mines, causing shut-downs and materially increasing the costs of operation. Revegetating the mine waste areas and improving the intervening forest areas would not solve all these acute problems of water control, but certainly would alleviate the difficulties of many situations.

To cope adquately with water and flood-control problems, studies on forest influences in relation to water are needed. No such work has been done

in the Northeast; what we assume to be true here is drawn from research done elsewhere under somewhat different soil, vegetational, and climatic conditions. Data derived from investigations in this section of the country would be much more reliable, and would enable forest managers, hydrologists, and flood-control engineers to plan and execute water regulatory measures with greater assurance of success. Intensive work in forest influences research is not included in present plans of the Anthracite Branch, inasmuch as another Branch Station to specialize in influences research is under consideration for the Delaware Basin. Establishment of that branch and inauguration of a research program in forest influences geared to Northeastern conditions depends now upon approval by the Congress.

GAME MANAGEMENT IN RELATION TO FORESTS

Game birds, animals, and fish are a natural resource, though perhaps a less important one, just as truly as forests or coal. An abundance of game provides not only recreation to devotees of rod and gun and many others satisfied merely to see wildlife, admire and let live; it also provides dollars-and-cents income to a community by expanding the market for various goods and services. Regulation of the take of game and positive measures to increase game populations have long been recognized as public responsibilities.

Game and forest are natural associates. The virgin wilderness abounded with game, as attested by many reports and records. Today, with the forests depleted as they are, and an ever-increasing number of those

who would hunt and fish, supplies of game seem never to be enough. Unbalances develop; some species unable to adjust to the conditions created by agriculture and forest cutting become rare or extinct; others find such conditions to their liking and, aided by man's control of certain predators, increase far above their former numbers. Deer populations, for instance, are belived to be much higher now in some sections than under virgin conditions, and instances of mass starvation from overstocking are a matter of record. Under such conditions of over-population, wildlife may become a destructive factor in the forest, consuming all reproduction and tree seeds, or girdling the bark from saplings and pole trees, according to the food habits of the animals involved.

Normally, there should be no conflict between forest management and game management where hunting is intelligently regulated to hold game in proper balance with food supply. In general, good forestry will favor game in that it provides a better balanced variety of food plant and cover conditions than existed in the virgin wilderness. Certain lands that by nature will never produce good forests can properly be set aside as game preserves, as is being done by many state game commissions. Here it may be feasible to manage some land definitely for game food production. Game research is outside the province of foresters. Probably the most essential action on the part of forestry agencies is that they work more closely with game and wildlife organizations to foster better understanding and to integrate forestry objectives and wildlife objectives more closely in the management of forest land.

RECREATION

Recreation could be a big business in several parts of the Anthracite Region. With 1½ million people within the boundaries of the region itself (a good portion of these live in urban areas) and another 30 million people living within a radius of 300 miles or not more than a day's automobile drive, what finer market could be desired for recreational facilities?

Many of the facilities are already at hand when the beautiful resort country in the Sullivan Highlands, the upper reaches of the Susquehanna River and the Pocono Plateau are considered. However, the conglomeration of ugly mine banks, burned-over barren areas, and the scars of clear-cutting have all helped to keep travellers and vacationists away from the region.

It was estimated in 1941 that the tourist public was spending $300,000,000 annually in Pennsylvania or a sum greater than the total cash income of all farms in the State. The Anthracite Region is already getting a portion of this huge income, but not as much as its natural attractions could provide. The exclusion of forest fires, revegetation of the barren areas and mine banks, and a change in present forest cutting practices will do much toward making the area attractive to the vacationist. In brief, healthier, more productive forests will help increase the flow of recreational dollars into the Region.

TAX DELINQUENCY

In May 1941 there were 63,000 acres of county-owned land in blocks of 50 acres or more no longer subject to redemption in 11 of the 15 counties.

In addition to this there were 57,254 acres in blocks of 50 acres or more still subject to redemption.

Land is probably not being surrendered for non-payment of taxes in 1947 to as great an extent as it was in 1941, but the problem is still there.

The average annual property tax on forest land varies between $0.08 and $0.21 per acre. In general, well stocked, thrifty forests on average sites are capable of paying these average rates. Nonproductive areas such as scrub oak, aspen-gray birch, and denuded mining areas cannot be expected to carry this burden. Changes in assessment practices might be helpful, but getting these areas into better production under forestry principles will do most in the long run toward solving this financial problem.

SUGGESTED PROGRAM OF PROJECTS FOR CURRENT ATTACK BY ANTHRACITE AREA BRANCH

It would not be difficult to draft a research program to include work on all the important forest problems of the Anthracite Area. This, however, would presuppose unlimited funds and research personnel. A harder task--and this is what must be done--is to select appropriate problems for research which is within the scope of the finances and personnel available.

On this realistic basis the following four main projects or lines of work are suggested for inclusion in the current program of studies for the Anthracite Area Branch. These broad projects are only briefly described. The reader should bear in mind that before studies are actually undertaken a detailed working plan must be written and that there may be several such studies within any one of the four projects listed.

1. Forest Stand Rehabilitation. The problems facing the Anthracite Area in the field of stand rehabilitation would seem by any standards to occupy high priority as a major project. There are two compelling reasons for a project in the northern hardwood forest type. One is that this type is the largest in the region and the other is that forest land in this forest type has a high production potential.

An initial task under this project would be to inventory and prepare for experimental management our new experimental forest in Wayne County. The major purposes of these experiments--most of which will be on a relatively large or pilot-plant scale--will be to develop the know-how of

management methods and to determine their costs; and to determine the growth, yield, and financial returns of the stands in the various experimental compartments. Some compartments of the experimental forest should be managed to grow mine props as the principal crop; some to produce high quality sawtimber; etc. The question of how much growing stock--the forest capital--is needed to get optimum growth and maximum net financial returns must be explored through experimentation. Another question, for example, is: Will thinnings, weedings, girdling, pruning, and other silvicultural improvements, which yield no current revenue, pay in the end through higher net returns?

Some work under this project undoubtedly would have to be done on sites away from the experimental forest. For example, sample plots and small-scale experiments in special stand conditions such as those of the mine-prop-study plots may be established. Accordingly, work under this first project while concentrated mainly on the experimental forest will not be confined to that one area.

2. Planting. This field of problems would also appear to rank high in the research program and hence it is set up as the second major project. For various reasons including availability of areas on which to work and the importance of the problem, the scrub oak lands would seem to warrant first attention. Such planting research is the first step in determining how best to convert scrub oak land to producing forests. Actually, a detailed plan is already well along for the planting experiments designed for the scrub oak area on recently acquired State land near Pimple Hill.

Planting studies on aspen-gray birch areas, on abandoned farm land sites and on mine waste banks are also needed. For the most part, however, these studies will probably have to be postponed because of limitations in the size of the Anthracite Area research unit. Some work on these studies is being done by other agencies, particularly the Chamber of Commerce at Wilkes-Barre, and the Station's Kingston office should cooperate to the extent possible in order to further such work.

3. Fire danger measurement. A third but smaller project could be undertaken in the field of fire protection. There is need for additional work on the fire-danger meter to increase the value of this instrument to fire-control agencies, particularly as it applies to fuel types other than the one in which the danger station may be located. It is believed that this work warrants early attention.

4. Working tools. A fourth line of research, although hardly a distinct project in itself, is the development of working tools needed in forestry, whether for carrying on research or for the practice of forestry. For example, there is need for new and improved volume tables, conversion factors, cull factors, method of predicting growth, etc. For the most part, such information can be developed in conjunction with research on the first three named projects.

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by members of the staff

Anthracite Area Branch Station

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Anthracite Area Forest Research

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